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AFQT Score Forecasting Models for Regional Estimation of Qualified Military Available

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AFQT SCORE FORECASTING MODELS FOR REGIONAL ESTIMATION OF QUALIFIED MILITARY AVAILABLE

by

Jeffery M. Peterson

June 1990

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Estimation of regional distributions of the qualified military available (QMA) population is essential for determining an efficient allocation of recruiting resources. Estimates of regional mental ability distribution are required in order to estimate QMA. Using data from the Youth National Longitudinal Survey (NLSY), logit regression equations are used to estimate the probability that a 17 to 21 year old high school graduate will score above the 50th percentile on the Armed Forces Qualification Test (AFQT). This probability is modeled as a function of sociodemographic variables including gender, race/ethnicity, parent's education, poverty status, income, residence in an urban area and receipt of welfare payments. Best fit equations are developed in order to facilitate calculation of nationwide county-level AFQT distributions.

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AFQT Score Forecasting Models for Regional Estimation of Qualified Military Available

by

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ABSTRACT

Estimation of regional distributions of the qualified military available (QMA) population is essential for determining an efficient allocation of recruiting resources. Estimates of regional mental ability distribution are required in order to estimate QMA. Using data from the Youth National Longitudinal Survey (NLSY), logit regression equations are used to estimate the probability that a 17 to 21 year old high school graduate will score above the 50th percentile on the Armed Forces Qualification Test (AFQT). This probability is modeled as a function of sociodemographic variables including gender, race/ethnicity, parents' education, poverty status, income, residence in an urban area and receipt of welfare payments. Best fit equations are developed in order to facilitate calculation of nationwide county-level AFQT distributions.

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I. INTRODUCTION

Manpower analysts and demographers continue to forecast a decline in the qualified military available (QMA) population until the mid 1990's. Nationwide, QMA population estimates of two million in 1990 are projected to decline to 1.8 million by 1995 at which time QMA population will start to increase and reach the two million mark again by the year 2000.[1] Depending on the magnitude of changes in military labor demand in response to proposed force reductions, a smaller QMA population could create significant upward pressure on the cost of recruiting quality enlistees. Coincidentally, there is continued pressure from the Congress to reduce military spending. Combined, these two situations reinforce the need for efficient recruiting operations. Central to high efficiency recruiting operations is the existence of accurate measures of regional recruiting market potential that provide the information necessary to allocate recruiting resources efficiently.

Econometric techniques developed thus far for estimating QMA involve a series of steps in which unqualified segments of the youth population are dropped. The remaining youth population constitutes QMA. Those dropped generally include individuals who: (1) fall outside an established age range (generally 17 to 21 years of age); (2) have not graduated from high school or attained a GED; (3) score poorly (generally defined as below the 50th percentile) on the Armed Forces Qualification Test (AFQT) or (4) fail to meet moral or medical qualifications for military service. This thesis focuses on the estimation of the proportion of the youth population in a given area that would score above the 50th percentile on the AFQT. Specifically, its primary purpose is to develop regression equations that accurately forecast these proportions so that county-level estimates of QMA can be developed nationwide.

[1]See Thomas (1990); page numbers have yet to be established for this draft document.

The research question to be answered is "what factors and individual characteristics, for which data are available nationwide at the county level, 'best' predict AFQT score?" Subsidiary questions include: (1) what model specification is most appropriate; (2) what variables are candidates for use in AFQT score estimating equations and (3) what are the specific equations that best predict whether an individual will score above the 50th percentile on the AFQT.

Since the primary purpose for developing these estimating equations is to forecast AFQT score distributions for each county, determining the independent effects of individual explanatory variables is of secondary importance. Therefore, the often encountered problem of multicollinearity in causal modeling will be of less concern.

This thesis makes no attempt to discuss or explain causative factors that determine mental ability. It attempts to identify those personal and socioeconomic variables that are statistically associated with AFQT score so that accurate forecasts of AFQT score distributions can be made for regional population subgroups. In this regard, this thesis borrows from the differential and developmental psychology literature inasmuch as this literature identifies variables statistically associated with mental ability.

The primary limitation of this model development effort is that only those variables for which data are available nationwide at the county level can be used. Once equations are estimated based on individual level data, county averages of the explanatory variables will be used to compute the estimated AFQT score distributions for all U.S. counties.[2] Therefore, the included variables must be supported by data collected by such agencies as the Census Bureau, Bureau of Labor Statistics or the Department of Commerce.

[2]The actual nationwide computation of these county distributions will be the subject of follow-on work and as such are not presented in this thesis.

The forecasting models are developed using individual level data from the Youth National Longitudinal Survey (NLSY). The NLSY, which contains 12,686 observations as of its first year in 1979, includes information on respondents' work, education, economic and family background histories. As part of the NLSY data collection process in 1980, the Armed Services Vocational Aptitude Battery (ASVAB) was administered to those in the survey in order to establish new test norms for the ASVAB.[3]

The basic model used is borrowed in large part from that of Goldberg and Goldberg (1989). This work, however, expands the number of explanatory variables and explores interaction effects among the variables in an attempt to improve predictive ability. Also, whereas previous efforts to model AFQT score distributions were conducted for high school graduates or the equivalent, this effort models AFQT score distributions for high school graduates with diplomas only (i.e., no GED's or other equivalencies).

[3]The ASVAB test scores and other data collected in the 1980 administration of the NLSY are commonly referred to as "The Profile of American Youth" or simply "The PROFILE". AFQT percentile scores, which are referred to throughout this thesis as simply AFQT scores, are calculated using raw scores from four ASVAB subtests. Appendix A contains a summary of the procedures for converting raw ASVAB subtest scores into AFQT scores.

II. LITERATURE REVIEW

The advent of psychological testing and the debate over what factors determine an individual's mental ability started in the latter part of the 19th century with the work of the British scholar, Sir Francis Galton. Galton believed that genetics determined mental ability and in his well known book entitled *Heredity Genius* (1869), he concluded that success ran in families because great intelligence was passed from generation to generation through genetic inheritance. As discussed in Weiten (1989), Galton's convictions regarding genetics were so strong that he advocated eugenics programs to improve the quality of the human race.

In 1905, Alfred Binet devised a test of mental ability at the request of a French education commission. The purpose of the test (Binet-Simon) was to identify those children with special educational needs so they could be afforded special training. The underlying theory for developing such a testing system was in contrast to that of Galton, for it suggested that the mental ability of subnormal children could improve with environmental changes. In the words of Alfred Binet, "The intelligence of anyone is susceptible of development. With practice, enthusiasm, and especially with method one can succeed in increasing one's attention, memory, judgement, and in becoming literally more intelligent than one was before." This set the stage for the long-standing debate on the determinants of mental abilit

In 1921 Lewis Termin started a study in which 1528 highly gifted students (IQ of about 150) were tracked throughout their lifetime. These students were reported to be: (1) above average in height, weight, strength and physical health; (2) superior in emotional adjustment and mental health and (3) socially adept and well liked.[4] In other studies researchers have found very strong correlations between the mental

[4]For a further discussion of Termin's work, see Weiten (1989).

abilities of identical twins. Some argue that this correlation results from genetic similarity while others argue that such twins generally develop under similar environmental conditions. In studies of adopted children, the nurture argument appears to dominate. Adopted children with no biological family relationship to the parents show intelligence levels similar to the parents. In other studies, children in understaffed orphanages and disadvantaged homes, once removed and placed in an improved setting, show marked increases in mental ability.

Some theorists advocate a reaction range model. In this model one's genetic make-up determines the range of one's mental ability while environmental factors determine one's actual mental ability within that genetically established range. While this theory is intuitively appealing it is difficult to test since it is difficult to measure the limits of one's genetically established range. Measurements of actual mental ability are, of course, much easier to obtain.

As the 20th century draws to a close, the debate no longer appears to be about which factor, nature or nurture, determines mental ability but rather on their relative importance. According to Weiten (1989), the positions in this debate range from those who argue that 80 percent of mental ability is determined by genetics to those who argue that this percentage is only about 40. For the interested reader there is a considerable amount of literature on this issue. Classic works include *Differential Psychology: Individual and Group Differences in Behavior* (1958) by Anne Anastasi, *The Psychology of Human Differences* (1965) by Leona Tyler and *Bias in Mental Testing* (1980) by Arthur R. Jensen. In *Educability and Group Differences* (1973), Jensen strongly challenges the nurture position and argues that heredity predominantly determines mental ability. For those choosing to pursue additional reading in this area, Eitelberg (1981) provides an excellent historical review and annotated bibliography on differences in population subgroup performance on tests of mental ability.

Throughout the nature versus nurture debate some general agreement on sociodemographic correlates did emerge. These include gender, race, age, educational attainment, geographic region and socioeconomic status as measured by father or mother's education level, poverty status or occupation. In the following studies the relationships between these correlates and performance on the ASVAB and the SAT are investigated. The first two studies, both of which relate to the ASVAB, are based on data from the PROFILE. The third study investigates SAT performance.

Bock and Moore (1984) started with a detailed review of the development and survey processes for the PROFILE and describe the psychometric properties of the ASVAB. They do a detailed analysis of the relationship between the socioeconomic characteristics (including interactions among these characteristics) of the sample and performance on the individual subtests of the ASVAB. They also discuss theories offered by behavioral scientists in order to provide insight into causal relationships associated with their findings. Because the authors analyze these socioeconomic variables with respect to performance on the individual subtests of the ASVAB and not with respect to AFQT score, the usefulness of their findings is somewhat limited for the purpose of developing models to predict AFQT score. In general, however, the findings presented do provide interesting insights into potential relationships between participant characteristics and their AFQT scores. Variation in ASVAB performance was found with respect to gender, race/ethnicity, geographic region, poverty status, age, educational attainment and mother's education.

The effects of gender were highly dependent on the subtest in question; females performed better on paragraph comprehension while males performed better on arithmetic reasoning and math knowledge. There were no appreciable differences between males and females on word knowledge. The effects of racial/ethnic background varied by subtest, but in general, whites significantly

outperformed blacks and Hispanics and Hispanics generally outperformed blacks.[5] Within the Hispanic group, Cubans performed better followed by Mexican-Americans and Puerto-Ricans. Geographic region at age 14 was also found to be related to general performance on the ASVAB. Consistent with other studies, individuals in the Northeast generally performed above the average while those from the Southeast performed below the average. These results did vary by racial/ethnic group. In particular, Hispanics in the Southeast and Midwest outperformed Hispanics from the West and Northeast. The authors credited part of the geographical differences in Hispanic scores to the social origins of the Hispanics living in those regions. Puerto-Rican Hispanics predominant in the Northeast, Cuban Hispanics in the Southeast and Mexican-American Hispanics in the West.

Economic status was characterized as either poor or not poor and was established in terms of the 1979 Office of Management and Budget (OMB) definition of poverty. Nonfarm families were defined as poor if the family income was less than or equal to $3770 plus $1230 times one less than the number of people in the family. For farm families these amounts were $3220 and $1040 respectively. In each racial/ethnic group, poor individuals scored lower than individuals classified as not poor.

In addressing the effects of age and educational attainment on ASVAB performance, the authors acknowledged that the independent effects of these variables were difficult to separate. They concluded, however, that ASVAB performance improves with educational attainment and that performance on some subtests improves with age while on others it declines. In general, performance on "school intensive subjects" declines with age, while performance on practical subjects

[5]The "white" racial/ethnic group includes individuals who are classified as "other" (i.e. not black or Hispanic).

improves. Generally the authors found that with respect to age and educational attainment, "test performance tends to be typical of the highest grade completed."

The final socioeconomic variable investigated was mother's education. Regarding this variable the authors stated, "increasing level of mother's education . . . is directly and strongly related to higher scores on all tests in the ASVAB battery." This finding is consistent with findings presented throughout the psychological testing literature and is generally attributed to the mother's predominate role in a child's formative years. Also, mother's education is strongly correlated (positively) with measures of economic status which generally means greater opportunity for vocational and educational attainment for the child.

Whereas the work of Bock and Moore (1984) focused on the effects of various socioeconomic characteristics on individual ASVAB subtest performance, *Profile of American Youth: 1980 Nationwide Administration of the Armed Services Vocational Aptitude Battery* looks specifically at the effects of socioeconomic variables on AFQT scores.[6] The results differ little from those presented by Bock and Moore (1984); however, because the AFQT score is the dependent variable, the findings apply directly to AFQT score forecasting.

Mean AFQT score increased with age: 46 for ages 18 and 19, 50 for ages 20 and 21, and 54 for ages 22 and 23. Overall, males had a slightly higher mean score than females, 50.8 versus 49.5; however, this varied by age group. Males in the 18 and 19 year age group had a mean score of 45 versus 46 for females. In the 20 to 21 year age group males had a mean score of 50 whereas females were one point behind at 49. The largest difference was in the 22 to 23 year age group with

[6]As in Bock and Moore (1984), this report uses data from the PROFILE. The study investigated the same variables as Bock and Moore (1984) with the exception of poverty status.

males averaging four points more than females; 56 versus 52. Mean AFQT score also increased with age in each racial/ethnic group.

With respect to racial/ethnic group, whites had a mean score of 56 while Hispanics and blacks were considerably lower with means of 31 and 24 respectively.[7] White and Hispanic males scored slightly higher than their female counterparts, while there was virtually no difference between the mean scores of black males and females.

Mean AFQT score improved considerably with the level of educational attainment. Non-high school graduates, including dropouts and those still in school, had a mean score of 27 whereas individuals with GEDs averaged 46. Individuals with a high school diploma or above had a mean score of 57. Consistent with other studies, there was a strong positive correlation between mother's education and mean AFQT score. Individuals whose mothers had an eighth grade education or less had a mean score of 29, while at the other extreme individuals whose mothers were college graduates or above had a mean score of 71.

Mean AFQT scores also differed by geographic region: New England-60, West North Central-58, Middle Atlantic-53, East North Central and Mountain-52, Pacific-50, West South Central-48, South Atlantic-44 and East South Central-42.[8] Again, these findings are consistent with those of other researchers in studies of mental ability.

In summary, the authors found that: (1) whites score higher than blacks and Hispanics; (2) AFQT scores improve with age and educational attainment; (3) there is a strong positive correlation between mother's education and AFQT score and

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[7]The "white" racial/ethnic group includes individuals who are classified as "other" (i.e. not black or Hispanic).

[8]The authors did not indicate whether the differences in AFQT scores discussed above were statistically significant.

(4) individuals in the Northeastern regions of the United States score above the average on the AFQT while those from the Southeastern regions score below the average.

A study by Behrendt, Eisenach and Johnson (1986) investigates the effects of school and family characteristics on state-wide average SAT scores in 1981 and 1982. The school and family characteristics studied are contained in Table 1 below. The dependent variable was the mean combined (math and verbal) SAT score for each state.

TABLE 1. **SCHOOL AND FAMILY CHARACTERISTICS STUDIED BY BEHRENDT, EISENACH AND JOHNSON (1986)**

SCHOOL

* average salary of teaching staff
* average non-salary school expenses per pupil
* average teachers per pupil
* average number of students per school (to capture scale effects)
* percentage of schools that were private
* whether or not there were state-wide high school graduation requirements

FAMILY

* percentage of population that was non-white or non-oriental
* percentage of population living in an urban area
* average number of siblings in families with children
* percentage of children in female-headed households
* percentage of population residing in the state for less than five years (to capture mobility effects)
* percentage of population with four years of college
* median family income for a family of four

Mean SAT score differed significantly by state as did the proportion of the students who took the SAT. The authors pointed out that since the brightest students were most likely to take the test, states with lower test participation rates would have higher mean scores, all else constant. They attempted to correct for this selectivity problem so that unbiased coefficient estimates could be produced.[9]

The authors concluded that school characteristics had little effect on SAT score. The average number of students per school had a statistically significant negative effect on SAT performance when only school characteristics were included in the model. The percentage of schools that were private had a statistically significant positive effect on SAT performance for the model that only included school characteristics and for the model that included both school and family characteristics.

The average number of siblings per family and the percentage of female-headed households had statistically significant negative effects on SAT performance for a model that only included family characteristics and for a model that included both school and family characteristics. The percentage of the population that had four years of college had a statistically significant positive effect on SAT performance in both models. The authors were surprised by the lack of significance for the percentage of non-white and non-oriental variable as this is contrary to most findings regarding minority performance on tests of mental ability. The authors explained that while there was a strong bivariate relationship between this variable and SAT score, the variable is apparently only a proxy for other demographic conditions such as larger families, fewer college educated parents and more female-headed families, all of which generally characterize minority families.

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[9]A discussion of the statistical procedures used to correct for this selectivity bias are beyond the scope of this brief summary. The interested reader can find a detailed explanation of the correction procedure on pages 365 through 367 of the paper.

The discovery of relationships between variation in mental ability and socioeconomic attributes such as those discussed above has provided manpower researchers with the insights necessary to model AFQT distributions for the purposes of regional QMA estimation. Curtis, Borack and Wax (1987) in a first attempt to estimate regional QMA, clustered like counties based on socioeconomic attributes that were correlated with AFQT score. An AFQT score distribution was then computed for each cluster and each county in the cluster was assumed to have that distribution of AFQT scores. While parsimonious, the aggregation of counties into several large clusters introduces biases and is dependent on only one or two explanatory variables. Subsequent methodologies such as those developed by Goldberg and Goldberg (1989) and Orvis and Gahart (1989) use maximum likelihood regression techniques to estimate the proportion of a population subgroup that falls into a given mental category as a function of a vector of explanatory variables. This approach allows each county's AFQT score distribution to vary with its socioeconomic composition; however, it is dependent on the availability of county level data to support the explanatory variables selected.

The purpose of Curtis, Borack and Wax' research was to produce estimates of QMA for the years 1984 through 1990 for each Marine Corps recruiting district and station and for each U.S. county. While the authors were able to produce county estimates, they advised against relying on them because of insufficient sample sizes and unavailability of some county level data. A process of elimination was used in which unqualified segments of the population were dropped. The remainder constituted QMA.

The authors used data from the PROFILE to calculate AFQT score distributions. Direct calculation of AFQT score distributions within racial/ethnic categories for each county was not possible as many counties are very small and not adequately represented in the PROFILE. Therefore, the authors first identified

variables that were highly correlated with AFQT score and for which data were available at the county level. For Hispanics and whites the level of education best predicted AFQT score. For blacks, the level of education and father's occupation best predicted AFQT score.

AFQT score distributions for Hispanics were calculated using the percent of adult Hispanics in the county with more than 12 years of education as a surrogate for level of education. All counties, including those not represented in the PROFILE, were grouped into four clusters: (1) less than 47 percent; (2) 47 to 56 percent; (3) 57 to 67 percent and (4) greater than 67 percent. The AFQT score distribution for each cluster was then calculated from the PROFILE participants in that cluster. Each county in the cluster was then assumed to have the same distribution of AFQT scores as the cluster itself.

AFQT score distributions for blacks were calculated using a variable known as the Socio-Economic Status Indicator (SESI) as a surrogate for father's occupation.[10] The counties were split into equal groups based on SESI. The lower group had a SESI of less than 41 while the upper group had a SESI of 41 or greater. Next, each SESI group was divided at its median on county educational attainment. The surrogate for county educational attainment was percent of adult blacks with at least 12 years of education. This produced four clusters of counties in which the AFQT score distribution for each cluster was calculated from the PROFILE participants in that cluster. Each county in the cluster was then assumed to have the same distribution of AFQT scores as the cluster itself.

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[10]SESI is based on income levels, home ownership statistics and educational, occupational and environmental characteristics that prevail in a county. It was constructed by Donnelly Marketing Information Services with Simmons Market Research prior to this research being conducted.

AFQT score distributions for whites were calculated using the county college completion percentage for adults as a first surrogate for level of education. Counties were initially subdivided into three groups: (1) less than or equal to 21.4 percent; (2) greater than 21.4 percent but less than or equal to 29.4 percent and (3) greater than 29.4 percent. Each of these three groups was then subdivided into two groups based on the high school completion rate for adults; this formed a total of six groups. The authors then combined two of these six groups because of their similarity in AFQT score distributions. This resulted in five clusters. The AFQT score distribution for each cluster was then calculated from the PROFILE participants in that cluster. Each county in the cluster was then assumed to have the same distribution of AFQT scores as the cluster itself.

Goldberg and Goldberg (1989) go a step beyond QMA estimation by using enlistment propensity data to estimate qualified military available and interested (QMA&I) population at the county and census region level. Specifically, their study is focused on forecasting QMA&I in the reserve recruiting markets. These forecasts are broken down by age (17-21 and 22-29), gender and racial/ethnic category (white, black and Hispanic) and are provided for 1988, 1990, 1995 and 2000.[11] The authors assume the following identity for QMA&I:

$$QMA\&I \equiv MA \cdot Q1 \cdot Q2 \cdot Q3 \cdot RPI$$

where,

MA, or military available, is the number of civilian high school graduates or equivalents,

Q1 is the proportion of MA that is medically qualified,

[11]The "white" racial/ethnic group includes individuals classified as "other" (i.e. not black or Hispanic).

Q2 is the proportion of MA that is morally qualified,

Q3 is the proportion of MA that is mentally qualified, and

RPI is a reserve enlistment propensity index.[12]

Data from the PROFILE were used to develop AFQT score forecasting models for use at the county level. This meant that the explanatory variables were limited to those for which data was available at the county level.

The authors assumed a multinomial logit functional form with four possible AFQT category outcomes: (1) 1-3A; (2) 3B; (3) 4A and (4) 4B-5. As an alternative for comparison purposes, a linear probability model was used in which each AFQT category outcome was independently regressed against the explanatory variables. Six separate forecasting models were developed based on gender and racial/ethnic category.

Consistent with other studies, differences in AFQT score distributions were found among the gender and racial/ethnic groups. Other significant explanatory variables included mother's education, poverty status, age, and East South Central census region. Puerto-Rican ethnicity was an important variable in the explanation of AFQT score for female Hispanics. Net family income was not significant in explaining AFQT score for any subgroup.

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[12]For MA the authors used Woods and Poole forecasts since they include noninstituitionalized, civilian high school graduates (or the equivalent) of relevant age segments (17-21 and 22-29 years old) for the years of interest. Medical qualification rates were those derived from the National Health and Nutrition Examination Survey, 1976-1980 (NHANES II) for individuals 16 to 24 years of age. Moral qualification rates were obtained from an Air Force study based on the juvenile delinquency rates in two U.S. cities. Reserve enlistment propensity indices were estimated using data from the Youth Attitude Tracking Survey (YATS) and were based in part on the work of Orvis (1986). For a comprehensive discussion of the procedures used to compute these propensity indices see pages 26-40 of Goldberg and Goldberg (1989).

In analyzing the within sample error the authors estimated the AFQT score distribution of high school graduates at the census region level using the forecasting models and regional level means of the explanatory variables.[13] Forecasted AFQT score distributions were then compared with the actual AFQT score distributions. The absolute percentage errors were lower for whites and declined as the AFQT categories were expanded such as from 1-3A to 1-4A. The authors considered the absolute percentage errors of between one and ten percent "relatively low." The linear probability model used for comparison gave smaller errors than the multinomial logit model; however, the authors concluded this was because the values of the explanatory variables were close to their means. The multinomial logit functional form was considered the preferred model for county level forecasting since county-level observations for explanatory variables may be extreme because of small samples.

Orvis and Gahart (1989) developed an AFQT score forecasting method that attempts to reduce a specific source of bias in estimating AFQT scores when the sample of ASVAB test takers is not representative of the target population. While this method can be used with a variety of national youth surveys, it was developed primarily with the characteristics of the YATS in mind. The authors merged the YATS data (1976-1980) with files from the Military Entrance Processing Station Reporting System through March 1985. The YATS respondents were from a stratified random sample of American youth; however, the characteristics of YATS respondents who take the ASVAB differ from those of YATS respondents who do not. Therefore, if a regression model was developed using only that portion of the sample which took the ASVAB, parameter estimates would very likely be biased and not representative of the target population.

[13]Goldberg and Goldberg (1989) defined a high school graduate as an individual who had completed 12 or more years of education.

To correct for this selectivity bias, the authors used the Heckman procedure which is a simultaneous two equation maximum likelihood (probit) technique designed to take into account: (1) the probability that an individual takes the ASVAB and (2) the correlation between the error terms of the equation for estimating the probability of taking the ASVAB and those of the equation which estimates AFQT score. The first equation, which estimates the probability of taking the ASVAB, was estimated using the entire YATS sample. The second equation, which estimates the probability that an individual will score in the upper 50th percentile on the AFQT, was estimated using those individuals who took the ASVAB.

The authors selected the upper 50th percentile since this is the population from which recruiting officials attempt to draw enlistees. Other percentile scores could be established as the cutoff point. The statistical model adjusts the parameters of the second equation to minimize the selectivity bias modeled by the first equation. The second equation can then be used with representative samples to estimate the probability that an individual will fall above a given cutoff percentile on the AFQT. Orvis and Gahart felt that the two equation method produces more accurate estimates of AFQT category than a single equation method.

This methodology for estimating AFQT category is particularly useful in that representative samples of individuals taking the ASVAB are not always readily available and therefore selectivity bias is a concern. However, as pointed out by Goldberg and Goldberg (1989), the models developed by Orvis and Gahart rely heavily on data collected through the YATS which are not available at the county or census region level. This severely limits the usefulness of this model for regional/county forecasting of AFQT score distributions.

III. THEORETICAL MODEL, METHODOLOGY AND DATA

Developmental and differential psychology research has demonstrated that performance on tests of mental ability is associated with gender, race, educational opportunities and attainment, family structure, parent's achievements as well as other related factors. Human capital theory also suggests that there is a relationship between an individual's mental ability and his income. In part, human capital theory assumes that an individual brings a "portfolio" of personal qualities and characteristics to the labor market for which employers are willing to pay. Such characteristics may include previous employment experience, special training, education, or mental ability as demonstrated on tests at the time of hiring or in on-the-job performance. The more these characteristics increase the individual's contribution to the firm's marginal product, the greater the amount of pay the employer is willing to provide the individual. From this theory and the findings of the psychological research discussed above, performance on the AFQT is assumed to be a function of an individual's sociodemographic characteristics.

In its recruiting efforts, the U.S. Armed Forces attempts to draw enlistees from the youth population that scores above the 50th percentile on the AFQT (i.e., mental categories I, II and IIIA). Recruiting officials generally consider high school graduates, ages 17 to 21, who score in the upper 50th percentile to be the "prime" or "quality" recruiting market. Therefore, in order to estimate the number of QMA youth in a given geographic region, the proportion of 17 to 21 year old high school graduates that can score above the 50th percentile on the AFQT must be estimated.

The data selected for modeling this proportion is the NLSY. The NLSY was initiated in 1979 in an attempt to study and better understand the labor force behavior of American youth. As discussed in Bock and Moore (1984), the NLSY sample consists of three independent probability samples: (1) a cross-section sample designed to represent the noninstitutionalized civilian segment of American young

people 14 to 21 years old as of January 1, 1979, in their proper population proportions; (2) a supplemental oversample of civilian Hispanic, Black, and economically disadvantaged non-Hispanic, non-Black (poor white) youth in the same age range; and (3) a military sample designed to represent youth aged 17 to 21 as of January 1, 1979 who were serving in the military as of September 30, 1978.[14]

The NLSY is weighted in order to compensate for the unequal probability of selection. New sample weights are computed each year to adjust for the characteristics of those respondents who drop out of the survey and the changing composition of the overall population the sample represents. The sample weights do not appear to change significantly from year to year and are set to zero for those years in which a respondent did not participate in the NLSY.[15]

During 1980 the ASVAB was administered to NLSY participants in order to establish new test norms.[16] In order to encourage maximum participation in the testing effort, an honorarium of $50 was paid to each NLSY respondent who took the ASVAB.[17] Of the initial 12,686 NLSY respondents, 11,914 actually took the test. This equates to a nearly 94 percent participation rate.

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[14]Sample sizes for these independent probability samples are: (1) cross-section-5766; (2) supplemental oversample-4990; and (3) military sample-1158. These sample sizes represent only those survey respondents who took the ASVAB.

[15]For a more comprehensive discussion of the sample construction and weighting scheme see Bock and Moore (1984) or chapter 4 of the NLSY Documentation 1979-1987 Background Materials, Attachments, Appendices, & Special Survey Documentation (reference 10).

[16]Until this point, test norms were still based on data from World War II, the last era in which extensive psychological testing was conducted.

[17]The military portion of the sample also took the ASVAB; their original ASVAB test scores upon enlistment were not used as their scores for this testing effort.

The partitioning of the NLSY data follows directly from the way recruiting officials define the "quality" recruiting market. Only high school graduates who were 17 to 21 years of age in 1980 are retained in the sample. To qualify as a high school graduate, a respondent had to report receiving a high school diploma during or before the 1981 administration of the NLSY.[18] Seventeen to 21 year old survey participants who received a high school diploma after 1981 were generally off of a normal education track. This observation is supported empirically in the NLSY data by their poorer performance on the AFQT as well as by the fact that the ratio of GED's to high school diplomas for such individuals is significantly higher than that for respondents who graduated in 1981 or before.

The sample of 17 to 21 year old high school graduates is then divided into six subgroups which include: (1) white males (WM); (2) white females (WF); (3) black males (BM); (4) black females (BF); (5) Hispanic males (HM); and (6) Hispanic females (HF).[19] Several factors support partitioning the data in this manner. First, as evidenced in Appendix B, the mean AFQT scores differ significantly among these six subgroups as does the percentage of individuals who scored above the 50th percentile.[20] Secondly, this partitioning is consistent with the distinction recruiting officials often make in setting recruiting goals for various population subgroups. And finally, if dummy variables are used to capture the effects of gender and race,

[18]For the purpose of this model, GED recipients are not considered high school graduates. Mean AFQT score for GED recipients is significantly lower than that of high school diploma recipients.

[19]"White" includes individuals who are classified as "other" (i.e. not black or Hispanic).

[20]As an additional notion of significant differences between mean AFQT scores for these six groups, Appendix C provides the results of an ordinary least squares model in which AFQT score is the dependent variable and dummy variables are included for the subgroups (white male is the base case). In addition to all of the coefficients for these subgroups being negative and, with the exception of Hispanic males, statistically significant, there are relatively large absolute differences in the size of the coefficients.

the coefficients and thus the effects of the remaining explanatory variables are forced to be the same for each subgroup. As the final model specifications show, this is very likely not the case.

Individuals in the military sample of the NLSY are retained in the samples for these six subgroups provided they meet the criteria for age and high school graduation status. A priori it was expected that retaining those in the military would bias the probability of being above the 50th percentile on the AFQT upwards since presumably these individuals were selected for military service in part because they scored above the 50th percentile. In fact, prior to partitioning the NLSY sample based on age and high school graduation status, a significant portion of the military respondents scored below the 50th percentile on the AFQT. Once age and high school graduation status are controlled for through data partitioning, the numbers of military individuals remaining in the subgroup samples are extremely small.[21]

As discussed earlier, previous research has clearly demonstrated a strong positive correlation between mother's education and performance on the AFQT. The models developed in this thesis, however, use average parents' education instead of mother's education.[22] Several factors support the use of this variable rather than mother's education. First, it performs as well as mother's education at explaining performance on the AFQT. Secondly, it helps reduce the relatively large number of missing values for mother's education. And finally, county-level data to support this variable is more readily available than it is for mother's education.

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[21]After dropping observations that fail to meet age and high school graduation status criteria and observations with missing values, the following numbers of military observations remain by subgroup in the final model specifications presented in Chapter 4: WM-1; WF-1; BM-2; BF-0; HM-0; and HF-0.

[22]For those observations in which one of the parent's education is missing, the other parent's education is used as the average parents' education.

Poverty and welfare variables are included as proxies for general socioeconomic status and are expected to have a negative effect on AFQT performance. Similarly, net family income is also included as an indicator of socioeconomic status and is expected to have a positive effect on AFQT performance.[23]

A dummy variable for living in an urban area is included to capture such effects as the quality of schools and educational opportunities the individual may have received. In general, a priori expectations are that living in an urban area will have a negative effect on AFQT performance for minorities since such individuals often attend inner-city schools with marginal education opportunities and standards. A better explanatory variable with which to capture such effects and perhaps interact with the urban variable is the type of school, public or private, that the individual attended. Surprisingly, the NLSY does not contain such a variable.

To capture the effects of a stable family life on AFQT performance, a dummy variable for whether or not an individual came from a dual-parent (or stepparent) family is investigated. A priori expectations are that individuals who come from a dual-parent home perform better on the AFQT than those who do not.

Interaction effects among these explanatory variables are also explored. Additionally, various census regions were also considered for inclusion in the models. While significant relationships exist between various census regions and performance on the AFQT, one must make the assumption that AFQT

[23]The variable for net family income in 1980 has a relatively large number of missing values (approximately 23 percent). To preserve the sample sizes, net family income in 1979 or 1981 was substituted when the 1980 net family income was missing. These income values were then deflated to 1967 dollars using the Consumer Price Index. T-tests indicate that the difference in real income between 1979 and 1980 was statistically significant in the white male, black male and Hispanic male samples. The difference in real income between 1980 and 1981 was statistically significant for black males only.

performance in each county is reflective of that for the entire census region in order to include this variable in the model. Such an assumption seems very unlikely and therefore census regions are not included as explanatory variables.

In summary, the explanatory variables chosen for investigation include: (1) parents' education; (2) poverty status; (3) whether or not the individual's family received government subsistence payments (welfare); (4) net family income; (5) whether or not the individual lived in an urban area; and (6) whether or not the individual came from a home with two parents and/or stepparents.[24]

In estimating the probability that an individual will score above the 50th percentile on the AFQT, it is assumed that the random errors affecting AFQT performance are logistically distributed. Therefore, the natural log of the odds ratio of scoring above the 50th percentile can be specified as:

$$\ln [P/(1-P)] = a + b\underline{\mathbf{X}} + u;$$

where

P = the probability that an individual will score above the 50th percentile on the AFQT

$\underline{\mathbf{X}}$ = the vector of sociodemographic explanatory variables discussed above, and

u = a random error term that is logistically distributed.

The logit functional form has several attractive properties. Unlike the linear probability model, the logit functional form constrains the probability to the range zero to one and does not assume that the effects of the explanatory variables on the probability of being in the prime market are constant. In those instances where

[24]Appendix D contains a table of the NLSY variable numbers and names that were used to construct the variables for the models developed.

a county-level average for a particular explanatory variable varies significantly from the mean of the explanatory variable used to estimate the model, the constant effects assumption would give less accurate estimates. The logit functional form allows the model to capture nonlinearities in the probability relationships.

IV. RESULTS

Comparisons of the means of the variables among the racial subgroups confirm a priori expectations and are consistent with previous research findings. The percentage of whites scoring above the 50th percentile is the highest followed by Hispanics and then blacks. Average parents' education for whites exceeds the 12 year level followed by blacks and Hispanics with approximately 11 and 9 years respectively. Whites are less likely to be in poverty or receiving welfare than are blacks or Hispanics--blacks are slightly more likely to be in poverty or receiving welfare than are Hispanics. Mean family income levels are also consistent with the findings for poverty status and welfare. Whites are less likely to live in urban areas than are blacks and Hispanics while Hispanics are more likely than blacks to live in an urban area. The descriptive statistics to support these observations are contained in Appendix B. Descriptive statistics for whether or not an individual lived in a dual-parent family are not provided in Appendix B as this variable was not included in the final model specifications; however, as expected, whites were more likely than blacks and Hispanics to come from dual-parent homes.

The logit regression equations presented in Table 2 below were calculated using the LOGIST procedure contained in release 5.16 of SAS at the United States Naval Postgraduate School. In addition to using the weighting option in the LOGIST procedure, the NORMWT option was used to normalize the sampling weights so that the sum of the weights equaled the actual sample size. Without the NORMWT option the standard errors for the coefficients are very small with very large chi-squared statistics which do not reflect the actual sample size.

The primary criterion used for selecting the "best" model was goodness of fit as measured by the percentage of individuals properly categorized as above or

below the 50th percentile and the model R statistic.[25] Other criteria including parsimony and theoretically consistent signs for variable coefficients were also considered.

TABLE 2. **AFQT MODEL RESULTS**

WHITE MALES

Variable	Coefficient	Std Error	Chi^2	P-value
Intercept	-2.322	.397	34.15	<.0001
Avg Parents' Ed.	.258	.032	63.91	<.0001
Welfare	-.133	.434	.09	<.7601
Poverty	-.111	.242	.21	<.6455
Income	-.0000039	.000011	.13	<.7171
Urban	.186	.162	1.31	<.2527

Model Chi-Square=87.31
R=.238
Percent Correctly Predicted=71.7

[25]The model R statistic measures the predictive ability of the model. For a complete discussion of this statistic see page 271 of the *SUGI Supplemental Library User's Guide* (1986).

WHITE FEMALES

Variable	Coefficient	Std Error	Chi^2	P-value
Intercept	-3.976	.389	104.49	<.0001
Avg Parents' Ed.	.404	.034	144.00	<.0001
Welfare	-.699	.370	3.56	<.0592
Poverty	-.435	.205	4.51	<.0338
Income	.0000045	.00001	.19	<.6602
Urban	-.391	.146	7.13	<.0076

Model Chi-Square=228.25
R=.348
Percent Correctly Predicted=69.1

BLACK MALES

Variable	Coefficient	Std Error	Chi^2	P-value
Intercept	-5.071	.826	37.68	<.0001
Avg Parents' Ed	.291	.061	22.56	<.0001
Welfare	-.039	.414	.01	<.9252
Poverty	-.835	.452	3.40	<.0650
Income	.000051	.000024	4.45	<.0350
Urban	.180	.437	.17	<.6813

Model Chi-Square=50.44
R=.316
Percent Correctly Predicted=79.2

BLACK FEMALES

Variable	Coefficient	Std Error	Chi^2	P-value
Intercept	-4.056	.631	41.26	<.0001
Avg Parents' Ed	.287	.054	28.60	<.0001
Welfare	-.802	.421	3.62	<.0571
Poverty	-.273	.289	.89	<.3451
Income	.0000064	.000025	.07	<.7977
Urban	-.750	.289	6.73	<.0095

Model Chi-Square=58.38
R=.308
Percent Correctly Predicted=82.8

HISPANIC MALES

Variable	Coefficient	Std Error	Chi^2	P-value
Intercept	-2.706	.614	19.41	<.0001
Avg Parents' Ed.	.195	.043	20.86	<.0001
Welfare	-.524	.596	.77	<.3797
Poverty	-.088	.492	.03	<.8580
Income	.000048	.000032	2.20	<.1377
Urban	.511	.538	.90	<.3421

Model Chi-Square=48.61
R=.370
Percent Correctly Predicted=66.2

HISPANIC FEMALES

Variable	Coefficient	Std Error	Chi^2	P-value
Intercept	-3.128	.984	10.10	<.0015
Avg Parents' Ed.	.198	.050	15.34	<.0001
Welfare	-2.162	1.212	3.18	<.0745
Poverty	-.801	.467	2.94	<.0866
Income	-.000014	.000032	.19	<.6664
Urban	.552	.894	.38	<.5374

Model Chi-Square=34.87
R=.315
Percent Correctly Predicted=78.9

An implicit assumption in the specification of each of these models which is neither theoretically consistent nor supported by the findings of previous research is that AFQT performance does not vary with age within the 17 to 21 year old range. Controlling for age would require county-level data on the age distribution within the 17 to 21 year old population. Since such data, not unlike that for other potentially important variables, generally are not available at the county level, this assumption must be made for the purposes of this model development effort. The omission of the age variable as well as other potentially important explanatory variables will undoubtedly introduce some degree of specification bias.

The bivariate relationships presented in Table 3 show no clear upward trends in the percentages of individuals scoring above the 50th percentile with increases in age; however, when a continuous variable for age is introduced into the final model specifications, the multivariate relationships appear more telling. For each model the coefficient for age is positive as expected and in the models for white males, white females and black females the coefficients are significant at the .02, .01 and .06 levels respectively. Additionally, the inclusion of the continuous age variable

improves the percentage correctly predicted in the models by as much as two percent.

TABLE 3. **PERCENTAGE OF RESPONDENTS SCORING ABOVE THE 50TH PERCENTILE ON THE AFQT BY AGE**

Age	WM	WF	BM	BF	HM	HF
17	.714	.659	.244	.149	.572	.291
18	.699	.679	.183	.175	.323	.179
19	.690	.683	.185	.190	.401	.218
20	.720	.679	.236	.138	.449	.221
21	.781	.659	.250	.263	.605	.301

Consistent with findings throughout the psychological testing literature and previous efforts to model AFQT distributions, parents' education has a strong positive effect on the probability of an individual scoring above the 50th percentile on the AFQT.

The coefficient signs for welfare and poverty are negative in each subgroup model confirming a priori expectations; however, welfare is only significant at conventional levels in the three female models while poverty is only significant in the white female, black male and Hispanic female models. With one exception, the effects of income were generally consistent with the finding of Goldberg and Goldberg (1989) that income has no significant effect on AFQT performance. In the black male model, income was significant at the .05 level.

A priori expectations for the urban variable were confirmed only in part. As a proxy for school quality and educational opportunity, as well as for other hard to

measure quality of life attributes, urban was expected to have a negative effect on the probability of a minority individual scoring in the upper 50th percentile on the AFQT. The results for this variable are interesting but not particularly easy to explain. For white and black males, urban has a positive but not significant effect at conventional levels on the probability of scoring in the upper 50th percentile. For white and black females on the other hand, urban has a significant (.01 level) negative effect on the probability of scoring in the upper 50th percentile. In both Hispanic models, urban has a positive but not significant effect.

The dummy variable for coming from a dual-parent family was not included in the final model specifications. While the variable has a positive and significant bivariate relationship with AFQT performance, no significant multivariate relationships could be obtained in alternative model specifications. Additionally, the variable did not increase the goodness of fit for any of the final model specifications.

Interaction effects among the explanatory variables were also investigated but none are included in the final model specifications. Again, significant bivariate relationships can be obtained between many of the interaction variables and AFQT score; however, significant multivariate relationships cannot be established nor do any of these variables improve the goodness of fit of the models.

The question of independent effects of the explanatory variables and the problem of multicollinearity were less of a concern since the primary criterion for model selection is predictive quality. A priori expectations were that the degree of multicollinearity among the variables would be "high" to "severe." Human capital theory suggests a strong relationship between parents' education and net family income. Since welfare is a function of poverty which is in turn a function of income, the collinearity among these variables was considered strong a priori. Surprisingly, these expectations were not confirmed. Using a linear probability

model with the same explanatory variables that are in the final logit models, condition indices and variance inflation factors of approximately 12 and 4 respectively were obtained from the SAS collinearity diagnostics.[26] Since multicollinearity is considered to be a sample phenomenon, the lack of strong collinearity among these variables is most likely attributable to the peculiar characteristics of the samples used in this study.

As a comparison of the models presented in Table 2 with those of Goldberg and Goldberg (1989), the estimated proportions of individuals who would score above the 50th percentile on the AFQT were computed at the means of the explanatory variables as contained in Appendix B.[27] A priori it was expected that the models developed in this thesis would estimate a higher proportion of individuals scoring above the 50th percentile since only high school graduates with diplomas were included in the subgroup samples. Confirmation of this expectation varied by subgroup.

The models developed in this thesis estimated higher proportions for white males, black males and black females while the Goldberg models estimated higher proportions for the remaining three models. While the model specifications do differ, the results in Table 4 indicate in part that the equations required to model the AFQT performance of high school graduates with diplomas differ from those required to model that of high school graduates including individuals with equivalencies.

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[26]See page 409 of Neter, Wasserman and Kutner (1989) for a discussion of variance inflation factors and page 301 of Gujarati (1988) for a discussion of condition indices.

[27]Variable means for East South Central census region and Puerto-Rican which are included in the Goldberg models were calculated for the appropriate subgroup samples in Appendix B.

TABLE 4. **COMPARISON OF THE ESTIMATED PROPORTIONS OF INDIVIDUALS SCORING ABOVE THE 50TH PERCENTILE ON THE AFQT**

Population Subgroup	Goldberg Model	Model in Table 2
WM	.732	.738
WF	.706	.672
BM	.141	.175
BF	.118	.141
HM	.472	.460
HF	.232	.177

V. CONCLUSIONS

The models in Table 2 support the suggestions of previous research that parents' education, poverty status and urban residence are good predictors of mental ability. Several additional conclusions arising from this work are also worthy of mention. First are the relative effects of the individual explanatory variables. The estimation and analysis of numerous alternative model specifications confirms that average parents' education is the best sociodemographic predictor of AFQT performance of the variables studied. While the other included variables have significant bivariate relationships with AFQT performance, their multivariate relationships are much less pronounced and consistent across gender/racial groups. Additionally, their ability to improve the goodness-of-fit for the models is small.

Secondly, the constraints on explanatory variables caused by NLSY data limitations and availability of county-level data provide little opportunity to expand the set of explanatory variables. School characteristics and investments per capita in education would seem to have the most promise in terms of expanding this set of variables; however, even if county-level data were available to support such variables, the NLSY surprisingly has no variable counterparts for such data. And of course, it is quite unlikely that the Department of Defense will sponsor another ASVAB testing effort such as the Profile of American Youth any time in the near future. While .her data sources such as the YATS could be used, these sources are not without their problems. In particular, sample sizes and selectivity bias render a data source such as YATS undesirable for the task of estimating AFQT distributions.

Perhaps the best prospects for improved estimation of regional mental category distributions lie in the national effort to reform our ailing school systems. If nationwide education standards and testing systems are established, the prospects

for obtaining accurate and precise estimates of mental category distributions at an observation level as low as the individual high school are encouraging.

Therefore, the model results of this thesis are likely to provide the best estimating equations for use in regional QMA analysis. These equations represent substantial improvement over previous efforts that included high school graduate equivalents with high school graduates who earned diplomas. These results represent the current state-of-the-art model for estimating the high quality recruiting market.

APPENDIX A

CONVERSION OF RAW ASVAB DATA TO AFQT PERCENTILE SCORES

AFQT percentile scores are computed using standardized scores for the Verbal (includes Word Knowledge and Paragraph Comprehension), Arithmetic Reasoning and Math Knowledge ASVAB subtests. The conversion of raw subtest scores to standard scores is accomplished through a linear transformation using a mean of 50 and a standard deviation of 10. Transformations are based on the data collected through the Profile of American Youth using the weighted population of 18 to 23 year old males and females. The formula to transform a raw subtest score into a standard subtest score (SSS) is as follows:

$$SSS = (10/S)\ (NC-X) + 50,$$

where

SSS = the standardized subtest score (round this result to the nearest integer: if it is less than 20 then raise it to 20 and if it is greater than 80 then lower it to 80)

S = the standard deviation of the subtest raw scores (see Table 1 for this value for each subtest)

NC = the number of questions answered correctly for the given subtest (for Verbal this is the sum of the number answered correctly for Word Knowledge and Paragraph Comprehension)

X = the mean of the subtest raw scores (see Table 1 for this value for each subtest)

Table A-1 provides the standard deviation (S) and mean raw score (X) for each of the subtests.

TABLE A-1. **ASVAB SUBTEST MEANS AND STANDARD DEVIATIONS**

ASVAB	Abbreviation	Mean	Standard Deviation
Verbal	VE	37.281	10.595
Arithmetic Reasoning	AR	18.009	7.373
Math Knowledge	MK	13.578	6.393

The total standardized sum of scores (TSSS) is then computed as follows: TSSS = 2(SSS for VE) + (SSS for AR) + (SSS for MK). The transformation from TSSS's to AFQT percentile scores is nonlinear. Table A-2 contains TSSS's, or ranges thereof, and their associated AFQT percentile score. Table A-3 recaps the transformation of TSSS's to AFQT percentile scores and shows the associated mental group categories.

TABLE A-2. **CONVERSION OF TOTAL STANDARDIZED SUM OF SCORES TO AFQT PERCENTILE SCORES**

TSSS	AFQT PCT SCORE	TSSS	AFQT PCT SCORE
95-120	1	155-156	15
121-124	2	157-158	16
125-127	3	159-160	17
128-131	4	161-162	18
132-134	5	163-164	19
135-137	6	165	20
138-139	7	166-167	21
140-142	8	168-169	22
143-144	9	170-171	23
145-146	10	172	24
147-148	11	173-174	25
149-150	12	175	26
151-153	13	176-177	27
154	14	178	28

TSSS	AFQT PCT SCORE	TSSS	AFQT PCT SCORE
179-180	29	218	64
181	30	219	65
182	31	220	66
183-184	32	221	67
185	33	222	68
186	34	223	69
187-188	35	224	70
189	36	225	71
190	37	226	72
191	38	227	73
192	39	228	74
193	40	229	75
194	41	230	76
195-196	42	231	77
197	43	232	78
198	44	233	79
199	45	234-235	80
200	46	236	81
201	47	237	82
202	48	238-239	84
203	49	240	85
204	50	241	86
205	51	242	87
206	52	243	88
206	52	244	89
207-208	53	245	90
209	54	246	91
210	55	247	92
211	56	248	93
212	57	249	94
213	58	250	95
214	59	251	96
215	61	252	97
216	62	253	98
217	63	254-258	99

Note: the 60th and 83rd percentiles are omitted

TABLE A-3. **RECAPITULATION OF TOTAL STANDARDIZED SUM OF SCORES, AFQT PERCENTILE SCORES AND MENTAL GROUP CATEGORIZATION**

TSSS RANGE	AFQT PCT SCORE RANGE	MENTAL GROUP
258-248	99-93	I
247-219	92-65	II
218-204	64-50	IIIA
203-182	49-31	IIIB
181-166	30-21	IVA
165-157	20-16	IVB
156-145	15-10	IVC
144-95	9-1	V

Note: (1) the range of the mental groups is not symmetrical about the 50th percentile
(2) AFQT scores are uniformly distributed.

This appendix was developed from information in Maier and Sims (1986) and from information received from Milton H. Maier at the Defense Manpower Data Center (East) (Autovon 226-0552).

APPENDIX B

TABLE B-1. WEIGHTED MEANS AND STANDARD DEVIATIONS

Variable	WM	WF	BM	BF	HM	HF
NOBS	1156	1384	389	530	204	227
% CAT I-IIIA	.722 (.448)	.646 (.478)	.214 (.410)	.187 (.390)	.462 (.499)	.241 (.428)
AFQT SCORE	64.540 (25.533)	59.542 (24.387)	31.337 (24.018)	30.381 (21.773)	47.007 (26.614)	34.828 (21.631)
AVERAGE PARENTS' EDUCATION	12.649 (2.528)	12.397 (2.414)	10.987 (2.603)	10.942 (2.797)	9.048 (4.644)	8.371 (4.027)
WELFARE	.022 (.146)	.028 (.165)	.173 (.378)	.197 (.399)	.104 (.305)	.135 (.342)
POVERTY	.086 (.281)	.098 (.297)	.205 (.404)	.326 (.469)	.152 (.359)	.250 (.433)
INCOME	10859 (6862)	9901 (6635)	6788 (5286)	6149 (4806)	8239 (6575)	6834 (5172)
URBAN	.789 (.408)	.760 (.427)	.863 (.344)	.802 (.399)	.888 (.316)	.946 (.226)

Note: (1) Standard deviations are given in the parentheses and are computed using the sum of the weights.
(2) See footnote 23 for a discussion of the income variable.

APPENDIX C

TABLE C-1. OLS MODEL USING DUMMY VARIABLES FOR THE GENDER/RACIAL SUBGROUPS

Variable	Coefficient	Std Error	T-statistic	P-value
Intercept	18.267	1.948	9.376	.0001
WF	-3.901	.792	-4.927	.0001
BM	-25.598	1.800	-14.220	.0001
BF	-25.977	1.603	-16.203	.0001
HM	-3.754	2.789	-1.346	.1784
HF	-12.978	2.712	-4.785	.0001
AVERAGE PARENTS EDUCATION	3.547	.148	23.991	.0001
WELFARE	-5.784	1.820	-3.177	.0015
POVERTY	-1.430	1.174	-1.218	.2232
INCOME	.000161	.0000583	2.767	.0057
URBAN	-.126	.903	-.140	.8886

F-value=160.211 R^2=.2923 N=3890

Note: (1) White males (WM) is the base case.
(2) Coefficients and standard errors are weighted.

APPENDIX D

TABLE D-1. **YOUTH NATIONAL LONGITUDINAL SURVEY (NLSY) VARIABLES USED IN DATA ANALYSIS**

Variable Number	Variable Description and Survey Year
R18	Urban or Rural Residence at Age 14 (1979)
R19	With Whom did Respondent Live at Age 14 (1979)
R65	Highest Grade Attended by Mother (1979)
R79	Highest Grade Attended by Father (1979)
R96	Racial/Ethnic Origin (1979)
R182	Does Respondent Have High School Diploma or Equivalent (1979)
R183	Which does Respondent Have, High School Diploma or GED (1979)
R1137	Is Respondent in Military Sample or Currently on Active Duty (1979)
R1915	Did Family Receive Welfare or Government Subsistence (1979)
R2148	Sex of Respondent (1979)
R2179	Total Net Family Income (1979)
R2202	Age of Respondent (1980)
R2299	Does Respondent Have High School Diploma or Equivalent (1980)
R2300	Which does Respondent Have, High School Diploma or GED (1980)
R4052	Sampling Weight (1980)
R4060.10	Total Net Family Income (1980)
R4181	Does Respondent Have High School Diploma or Equivalent (1981)
R4182	Which does Respondent Have, High School Diploma or GED (1981)
R6151	ASVAB Subtest Raw Score; Arithmetic Reasoning (1980)
R6152	ASVAB Subtest Raw Score; Word Knowledge (1980)
R6153	ASVAB Subtest Raw Score; Paragraph Comprehension (1980)
R6157	ASVAB Subtest Raw Score; Mathematics Knowledge (1980)
R6184.10	Total Net Family Income (1981)
R6185	Family Poverty Status in 1980 (1981)

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